Changes

Engineers made several minor changes to the design before and during construction of the project. The changes were necessary for proper function of the river, as well as for adaptation to unforeseen on-site conditions. Other changes to the contract work were implemented during construction and were not related to the geomorphic design.

Design Changes

Channel:

Beginning at the upstream end of the channel, the first change involved the addition of graded material to the surface of riffles between stations 14+00 and 21+00. By the end of production of the graded material, it was clear that there would be more material produced than would be needed for the riffles and point bars in the design channel. Engineers directed the contractor to use some of it to augment the riffles in the section of channel that had not been modified. This should improve the likelihood that this reach will be used by spawning salmon because the native material was relatively large and armored.

The next change from the original design was the transition from the existing upstream reach to the new design channel. Engineers determined during construction that transitioning the design channel into the existing channel between station 23+00 and 25+00, rather than upstream of 23+00 as planned, would preserve the native riffle from station 22+00 to 23+00 and improve its stability over the original plan.

Figure 11 - Backwater Modification

At about station 79+50, the design backwater channel meets the design channel. Dimensions of approximately 400 feet of the backwater channel near its mouth were modified from the original plan (Figure 11). Engineers and biologists determined that if the portions that ran through the existing vegetated pond were maintained at the existing depth, it would increase habitat diversity and accelerate volunteer revegetation. The result is that, for that portion of the backwater channel, the depth and width are generally larger than what was designed.

Another modification was made at the downstream end of the design channel. Site conditions required a change in design to accommodate the transition to the existing channel. From stations 112+00 to 116+00, the channel was shifted 84 feet to the south of design location. This, in turn, required that the channel be shifted left by 14 feet per

100 feet of channel length from stations 106+00 to 112+00. The changes did not result in any appreciable increase in overall channel length, but allowed for a smoother transition to the existing channel on the other side of the bridge. Further work in this area may be necessary during construction of the next phase depending on the final design configuration of that phase.

One last modification to the original channel design was the addition of experimental features to several of the design riffles. This project gave designers the opportunity to scientifically evaluate spawning utilization for different riffle designs that will be monitored through a separate grant. The modifications were made to six of the twelve design riffles and varied in design only by the number of the features per riffle (see Figure 12 and Appendix C). Construction took place during the two days preceding diversion of water to the new channel.

Figure 12 - Riffle Modification

Floodplain:

At the upper most end of the project, the floodplain was designed to narrow on the south side until meeting the river channel at about station 4+00, but several conditions during construction required us to leave the floodplain from 4+00 to about 8+00 mostly intact (Figure 13 and Appendix A, Sheet A2). The first condition was that the final easement property line did not include the upper 200 feet of the floodplain, so work in that area would have required additional negotiation with the landowner. Second, the landowner was working on a sump in that area to supply the irrigation line, and part of the area was being used as a stockpile for the excavated material. Third, a small area with established trees had a ground elevation close to the design floodplain elevation. Leaving that area in place provided benefit to the project but had little hydraulic impact.

Figure 13 - Upper Construction Limit

Once the landowner's excavations are removed, the hydraulic properties of the area should not be significantly different from the original design.

During excavation of the Borrow Site 3 area (south side floodplain delta from stations 45+00 to 50+00), inspectors determined that the area would remain more stable if an existing gully that carried water from the upper bluffs was conserved and kept separate from the floodplain for most of its length. As a result, the Simulated Abandoned Channel that was planned in that area had to be shifted to the north about 80 feet at its downstream end to accommodate the gully.

Figure 14 - Floodplain Terrace

Just downstream of the gully, engineers added a floodplain terrace feature. During construction, they determined that there might be excess material left after all fills had been completed. They designed a temporary terrace approximately two feet above floodplain grade and constructed it along the toe of the south bluff between stations 51+00 and 66+00 (Figure 14, Appendix G). The intent was to use some of the terrace material in other areas if it became necessary later during construction, but would otherwise leave it in place permanently. The area will not significantly impact the hydraulics of the floodplain, but will allow for different types of plantings and increase diversity.

The design pond was built as planned, but the nature of the material excavated from it was much more impermeable than engineers had predicted. As construction of it neared completion, it was obvious that infiltration of water from the river channel was not occurring as expected. Since this infiltration is necessary to maintain a water elevation similar to the nearby river's flow level, engineers designed and implemented a French drain (trench filled with clean gravel) from the edge of the river channel at station 86+00 to the downstream lobe of the pond (Figure 15 and Appendix A, Sheet A2). The structure was excavated through the floodplain to the elevation of the pond bottom and a width of ten feet.

Figure 15 - French Drain Construction

The trench was then filled with the graded material so that water will flow through it to quickly fill or partially drain the pond when river flows fluctuate. It was then covered with one to two feet of native material to encourage vegetation growth over it.

Figure 16 - Salvaged Wetland

The Simulated Abandoned Channel (SAC) that was designed to stretch from station 60+00 to 94+00, surrounding the pond, was slightly altered. The original plan called for it to completely surround the pond and its islands including the area between the pond and haul road. Although most of the area was constructed as designed, engineers determined that a large portion of the existing wetlands between the downstream island and the haul road was at an elevation similar to the design elevation. Since the existing habitat was more valuable than what could be constructed and revegetated, it was kept as it was and construction worked around it (Figure 16, Appendix D). The arm of the SAC that was to lead downstream from the pond was also not constructed for two reasons: first, it was determined that much of the water maintaining the salvaged wetlands would likely drain out via the SAC; and second, the end of it would have traveled through two rows of mature trees that we preferred to leave in place.

Part of the north floodplain adjacent to the bridge at station 114+00 was not constructed as originally planned. The design had called for the material around the abutment to be removed down to floodplain elevation. The Department of Transportation plans to rebuild the bridge with an opening 100 feet wider to the north side, so the excess material along the abutment will have to be removed. The easement negotiated for the restoration project did not include that area, however, so no work could be done there. It is possible that during construction of the bridge the Department of Transportation will remove the material as part of the bridge removal process. Otherwise, the material will be removed during construction of the next phase downstream.

Although the original plan called for up to 100% of the vegetation to be removed and then revegetated after construction, one of our goals was to save as much of the mature vegetation as possible. From the beginning of construction, the contractor was asked to avoid removal of trees that were within two feet of design elevation at their base. The request proved valuable in the end because large portions of the canopy were saved which required minimal changes to the design topography (see Appendix D).

Project Additions

The constructed channel required less than the estimated 60,000 cubic yards of graded material to complete, so the stockpile was moved to an on-site storage area. The

Figure 17 - Graded Material Stockpile

material will be used in the channel for future gravel augmentation work. Approximately 8,000 cubic yards of the material was placed in a stockpile 50 to 100 feet wide and five to six feet tall (Figure 17). It is located on the south floodplain at the toe of the bluff between stations 38+00 and 44+00 (Appendix A, Sheet A2).

During design for the revegetation of the project, designers determined that irrigation would be necessary for the south floodplain upstream of the backwater. Originally it was intended that the supply pipeline would be installed in the early spring after project construction was completed, but it was later determined that irrigation would be necessary in early spring, which meant the pipeline would have to be operational by the end of construction. Planners decided to take advantage of the current construction contract to install the line. It extends from a pump near the river at station 10+00, across the farmed terrace south of the floodplain, and runs directly through the south floodplain from stations 46+00 to 78+00 (Figure 18, Appendix E). The line will accommodate both flood and drip irrigation of the plantings.

Figure 18 - Pipeline

Another item added to the original design was the haul road along the toe of the bluff at the right edge of the north floodplain between stations 89+00 and 114+00 (see Appendix F). In an agreement with the landowner, the Department relocated the haul road along the bluff toe to reduce the impact to floodplain hydraulics. Steps were also taken to direct runoff to the design pond via a system of drainage including a ditch between the road and bluff which drains to a culvert across the road at station 97+00. The culvert then drains to a new ditch which runs from station 97+00 to the pond at station 87+00 following the toe of the bluff and the edge of the salvaged wetlands.

At the end of construction the contractor determined that there was not enough material left on the north side floodplain to complete it to specifications. Since the bridges across the channel had been removed, the excess stored on the south side was not readily accessible to them. To help the contractor complete the floodplain construction in a timely manner, engineers added a short, narrow section of shallow channel (similar to a SAC but draining upstream to the pond rather than downstream) to follow part of

Figure 19 - Ditch and Narrow SAC

the drainage ditch between the culvert and pond (Figure 19 and Appendix A, Sheet A2). Construction of this feature provided enough material for other areas of the floodplain that required additional fill. Since the lower arm of the SAC around the pond was not constructed, this addition did not increase the overall area of SAC on the project site.

Challenges

One of the major challenges to construction of the project was the disposal of deleterious materials uncovered during construction. Several materials were uncovered that required special attention, including concrete, remnants of the former railroad crossing pilings which contained creosote, and some deposits of asphalt concrete. There were several sources of concrete found on site. A large buried bay with concrete walls was uncovered in the design pond area, as well as several large pieces of concrete probably abandoned when a gravel mining operation left the site. There were also several sections throughout the reach where concrete from past demolition had been used as rip rap bank protection. In all cases the concrete was broken up into manageable sizes and transported by dump trucks to the deeper portions of the existing mine pit ponds (below channel invert) along the south bluff and buried. The sites were chosen for the greater depth of fill and distance away from the design channel. Other materials such as the creosote poles and asphalt concrete posed an environmental concern and were hauled away from the project site and disposed of at an approved disposal site. Gravel material that had surrounded the creosote poles was used as base fill in the construction of the haul road after Department testing and county approval.

Another problem that was encountered during construction was the excessive seepage of farm irrigation water onto the north floodplain and into channel excavations. The problem was worst during seasonal irrigation of the adjacent alfalfa fields, but was an issue throughout the duration of construction. A complex system of settlement ponds and drainage ditches were used to dewater the area downstream of station 90+00 because the water picked up silt in the work area and could not be allowed to drain to the river before it settled out (Figure 20). Upstream of station 73+00, the contractor maintained a long ditch between the haul road and the constructed floodplain, which drained water to the design pond so that it would not spill out onto the floodplain. These actions were in response to this unforeseen challenge and took time to develop during construction, but they were ultimately effective in aiding the contractor to complete the work required.

Figure 20 – Dewatering and Settling System

Diversion of the river flow from the existing channel to the newly constructed design channel also proved to be a significant challenge. Most of the design channel was constructed in relatively dry conditions while the river bypassed it until channel construction was complete. As sections were completed, the water was diverted to the new channel, but careful consideration was given to the process by the contractor and

Figure 21 - Split Flow

inspectors to ensure that all permit requirements were complied with. The flow was slowly increased to the new channel while maintaining flow in the old channel resulting in a split flow between the two (Figure 21). That flow was then maintained for at least 24 hours before the former channel was closed off at the downstream end. This was to ensure that flow downstream was not cut off for any period of time, and water in the former channel was never drained. As each section of former channel was closed off at the lower end, some inflow was necessary, as well as relief ditches along the length of it, which allowed water to flow back into the new channel. The former channel was then filled from the downstream end moving upstream so that wildlife would be forced back and out into the new channel through the relief ditches.

Figure 22 - High Water Work

Toward the end of channel construction, we faced the challenge of higher flows. Flows were increased from about 200 cfs to around 700 cfs for the last two weeks of October, just before work began on the portion of the channel which could not be bypassed. As a result, the contractor had to configure the design channel in water up to six feet deep (Figure 22). They were forced to modify their construction procedures, and inspectors also had more difficulty checking grade of the channel due to the swift water. To ensure the channel's completion before October 31st, the Department issued an acceleration order to the contractor.

One more challenge engineers faced was the unexpected lack of hydraulic connection between the constructed design pond and the design channel. Much of the sides and bottom of the pond contained a large amount of clay, which impeded groundwater flow. This presented a problem because the pond is meant to maintain a water level similar to that of the nearby reach of river. Engineers devised a solution based on the French drain concept described on page 11.

Materials management presented a very significant challenge for the contractor on this project. With the "borrow sites" being used both for random fill and select channel material, and Borrow Site 2 also being used as source material for the screening

operation to create the graded material, the complexity made it difficult to be efficient. In the end, the contractor had a surplus of material on the south side in Borrow Site 2, but a deficit on the north side in Borrow Site 1. Department engineers had to come up with ways to adapt to these conditions, such as the terrace, the narrow SAC, and the graded material stockpile mentioned in the Changes section of this report.

One of the highest priorities of Department inspectors during the construction of this project was to comply with permit requirements (see Appendix H for partial list of requirements). All special status species, as well as common fish and wildlife species, were handled with care throughout construction. At the beginning, nesting Swainson's Hawks in a tree near the project boundary meant machinery had to be kept out of a large portion of the upstream end of the project until hatchlings fledged. The contractor also had to stay out of a potential woodrat nesting site until biologists were able to determine whether or not the animals were present. Every person who came to work on the project had to first go through training so that they knew what to look out for and what to avoid. This training was offered as frequent tailgate meetings held by Department environmental scientists. During filling of the wetland areas, biological monitors worked closely with the operators, and the contractor was forced to fill at a steady pace to allow wildlife to exit ahead of the equipment. The Department paid for an extra excavator used to create exit channels through the wetland grasses during this process (Figure 23). While the former channels were being filled, water continued to flow through them and out relief channels so that they would not dry out and fish could escape.

Figure 23 – Excavator used for Wetlands

Another challenge the contractor and inspectors faced was the shortened window of time available for construction. Because of delays in approval of some of the permits, construction began in mid-July rather than in early June. This delay proved to complicate matters for the channel construction because of the October 31st deadline for water work.

One last important challenge to both equipment operators and inspectors was safety. The inspectors and environmental monitors often had to work in close proximity to the heavy earth moving equipment. The contractor took a very proactive approach to the subject and was quick to remedy any unsafe conditions or circumstances, but all personnel had to be vigilant in keeping the work site safe.